IS 12448-3 (1989): Basic testing procedures and measuring methods for electromechanical components for electronic equipment, Part 3: Current carrying capacity test [LITD 3: Electromechanical COmponents and Mechnical Structures for Electronic Equipment]

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Indian Standard

BASIC TESTING PROCEDURES AND MEASURING METHODS FOR ELECTROMECHANICAL COMPONENTS FOR ELECTRONIC EQUIPMENT

PART 3 CURRENT-CARRYING CAPACITY TESTS

भारतीय मानक

इलेक्ट्रानी उपस्कर के विद्युतयांत्रिक घटकों की आधारभूत परीक्षण प्रक्रियाएं और मापन पद्धतियां

भाग 3 धारा वहन क्षमता परीक्षण

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Electromechanical Components for Electronic Equipment Sectional Committee, LTDC 7

FOREWORD

This Indian Standard (Part 3) was adopted by the Bureau of Indian Standards on 23 March 1989, after the draft finalized by the Electromechanical Components for Electronic Equipment Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

The object of this standard (Part 3) is to lay down uniform methods of tests for measuring temperature rise and assessing current-carrying capacity of electromechanical components.

This standard (Part 3) is based, without any technical change, on IEC Pub 512-3 (1976) 'Electromechanical components for electronic equipment : Basic testing procedures and measuring methods Part 3 Current-carrying capacity tests', issued by the International Electrotechnical commission (IEC)'.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

BASIC TESTING PROCEDURES AND MEASURING METHODS FOR ELECTROMECHANICAL COMPONENTS FOR ELECTRONIC EQUIPMENT

PART 3 CURRENT-CARRYING CAPACITY TESTS

1 SCOPE

1.1 This standard (Part 3) covers test methods for measuring temperature rise and assessing current-carrying capacity of electromechanical components.

2 TEST 5a: TEMPERATURE RISE

2.1 General

The object of this test is to detail a standard test method to assess the ability of a component to carry continuously its specified current without exceeding a specified temperature rise.

2.2 Preparation of the Specimen

The specimen shall be fitted with temperature-sensing device(s), wired with a minimum length of 500 mm of the specified size wire, and mounted as specified in the detail specification.

NOTE — Care shall be taken to protect the specimen under test from draughts or other artificial cooling.

2.3 Test Method

A specified test current shall be applied to each contact of the specimen for a period of 5 h.

Ambient temperature shall be recorded before and after the test.

2.4 Requirements

a) Every contact of the specimen must be capable of carrying the specified test current for a period of 5 h without exceeding the specified temperature rise.

2.5 Details to be Specified

When this test is required by the detail specification, the following details shall be specified:

a) Location and sensitivity of temperature-sensing device(s),

b) Wire size,

c) Wiring of specimen and type of termination,

d) Mounting of specimen,

e) ac or dc current,

f) Temperature rise (preferred values are 20, 30 and 40° C),

g) Ambient temperature, and

h) Any deviation from standard test method.

3 TEST 5b: CURRENT-TEMPERATURE DERATING

3.1 General

The object of this test is to detail a standard test method to assess the current-carrying capacity of electromechanical components.

3.2 General Conditions

3.2.1 *Determining the Current-Carrying Capacity Curve*

The current-carrying capacity is limited by the thermal properties of the materials which are used for the contacts and terminals as well as by the insulating materials. Therefore, it is a function of the self-generated heat and the ambient temperature within which a device is operating.

Using the measuring method given in **3.4**, the temperature of a measuring point t_b (approximately the hottest spot) of the component and the temparature in the immediate environment t_u of the component are measured at various currents. The difference between the two temperatures is the self-heating or rise created by the current flow. This may be expressed as:

$$t_b - t_u = \Delta t$$

The relation between the current, the temperature rise and the ambient temperature of the component is represented by a curve as shown in Fig. 1. Unless otherwise specified, the temperature rise is based upon the mean current of three specimens. The mean value derived from the measured values of these three specimens serves as the basic curve. At least three points of the basic curve shall be established.

The permissible upper-limit temperature of the materials employed is plotted as a vertical line on the graphs shown in Fig. 1 and 2, with current I as the ordinate and the temperature t as the abscissa. The temperature rise Δt (mean value of three specimens), determined at current I_n, is deducted: From this, the maximum permissible ambient temperature t_u for the load current I_n is obtained since the sum of the ambient temperature t_u and the temperature rise Δt must not exceed the upper temperature limit of the material.

3.2.2 *Derating Curve*

A derating curve, derived from the basic curve (*see* Fig. 2) determined in accordance with **3.2.1**, shall be specified in the relevant detail specification. This curve takes into account variations in specimens as well as errors in temperature measurements in the measuring equipment.

The derating factor is justified because the current-carrying capacity may be limited further by external factors, for example, the size of the wire and unequal distribution of the loaded circuits. If these factors result in a current-carrying capacity other than that which may be expected due to thermal limitations, then a revised value shall apply.

NOTE — In practice, it is usually the case that all terminals are not loaded simultaneously with the maximum permissible current. In many cases, the individual terminals can carry several times the derated current indicated by the derating curve when less than 20 percent of the total complement is used.

For these cases, general rules cannot be established and the limits shall be determined for the individual case. It is recommended that the method described in this standard be used accordingly in these cases.

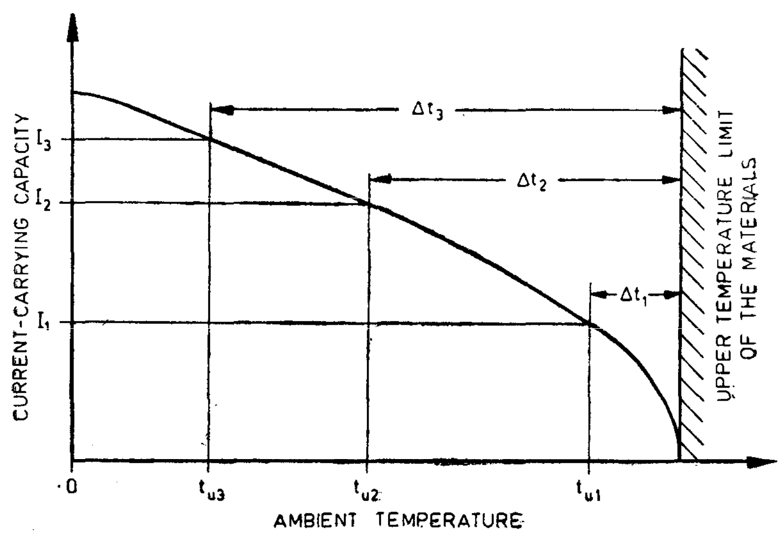

FIG. 1 EXAMPLE OF A CURRENT-CARRYING CAPACITY CURVE

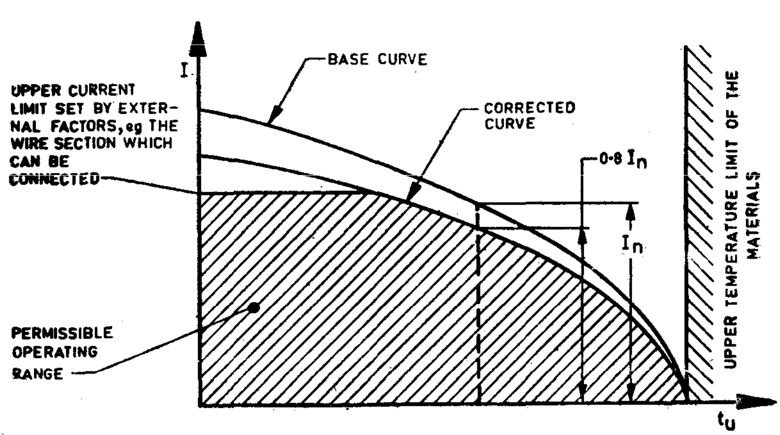

FIG. 2 EXAMPLE OF A DERATING CURVE

3.2.3 *Application of the Current-Carrying Capacity Curve*

The derating curve determined in accordance with **3.2.2** represents the official current-carrying capacity curve as defined by this standard. Since it gives the maximum permissible current as a function of the ambient temperature, it is truly a derating curve. The cross-hatched area shown in Fig. 2 indicates the permissible operating range.

NOTE — If the detail specification specifies current-carrying capacity data, then the current-carrying curve given in this standard shall be cited. If values in tabular form are preferred, they should coincide with the current-carrying capacity curve.

3.3 Details of the Test

3.3.1 *Measuring Apparatus*

The measurement shall be carried out in air as undisturbed as possible. Therefore, the specimen shall be mounted in an enclosure which protects the immediate environment from external movements of air. The enclosure should be made of a non-reflective material.

The sides of the enclosure may be movable to accommodate different specimen sizes. The sides shall not be closer than 20 cm from the edges of the specimen. The enclosure is not required to have a lid.

The specimen is arranged in the enclosure in a horizontal attitude 5 cm above the bottom of the enclosure and at least 15 cm below the top and equidistant from the sides. As nearly as possible, the specimen shall be in free suspension. If this is not possible, a thermal insulating material with a thermal conductivity of ⩽ 2 W/mK may be used provided that not more than 20 percent of the surface of the specimen is in contact with the insulating material.

The specimen shall be connected with wires of suitable cross-section for the maximum current to be expected or according to the size of the termination. In order to reduce external heat dissipation to a minimum, at least 25 cm of the connecting wires shall be within the measuring enclosure. In the case of multipole specimens, all contacts shall be wired in series with wire the same size as the connecting wires. These links shall be 25 cm in length.

NOTES

1 In the case of specimens with moving contacts, care shall be taken that the contacts are not disturbed by the connecting wires.

2 A mated connector set is considered a single specimen.

3 When the specimen is a free connector with a cable attached, at least 25 cm of the cable shall be contained within the measuring enclosure. The series connection of the contacts shall be made through the attached cables at a distance of 25 cm from the specimen.

3.3.2 *Details of Temperature Measurement*

The temperature is measured with two temperature probes. The probe leads pass through insulation walls of the measuring apparatus.

The measuring point for measuring the ambient temperature shall be located in a horizontal plane passing through the axis of the specimen. It shall be located 5 cm from the mid-point of the edge of the longest side of the specimen.

The measuring point for measuring the temperature of the specimen shall be stated in the detail specification.

NOTE — The temperature probes could be thin thermocouples, for example, nichrome/nickel wire with a diameter ⩽ 0·3 mm. If thermocouples with the same type of calibration curve are used for both temperature probes, they may be connected in opposition in the measuring circuit. In this case, the temperature rise Δt is measured directly (*see* Fig. 3). However, t_b should be monitored to ensure that it does not exceed the upper temperature limit of the materials.

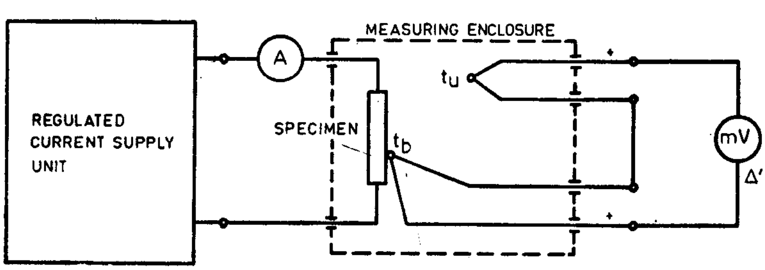

FIG. 3 MEASURING APPARATUS ARRANGEMENT

3.4 Method of Measurement

The specimen is arranged in the measuring enclosure as described *in* **3.3.1** and *its terminals* are connected to a regulated power supply through an ammeter.

The loading current may be ac or dc and when ac current is used, the rms value applies.

The current shall be maintained for a period not to exceed 1 h, or until thermal stability is achieved, at each of the selected current levels.

3.5 Details to be Specified

When this test is required by the detail specification, the following details shall be specified:

a) Preparation of the specimen;

b) Type and size of cable/wire bundle to be used;

c) Measuring point for specimen temperature;

d) Upper temperature limit;

e) Number of specimens, if other than three; and

f) Any deviation from the standard test method.

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BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices :	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	331 01 31 331 13 75
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	36 24 99
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	2 18 43 3 16 41
Southern : C. I. T. Campus, IV Cross Road, MADRAS 600113	41 24 42 41 25 19 41 29 16
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